Anybus® CompactCom™ B40 Modbus Serial

PROFINET IRT

NETWORK GUIDE

SCM-1202-138 1.1 en-US ENGLISH

Connecting Devices™

Important User Information

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1 Preface

1.1 About this Document

This document is intended to provide a good understanding of the functionality offered by the Anybus CompactCom B40 Modbus Serial - PROFINET IRT.

The reader of this document is expected to be familiar with high level software design and communication systems in general. The information in this network guide, along with the Anybus CompactCom B40 Modbus Serial user manual should normally be sufficient to implement a design. However, if advanced PROFINET IRT specific functionality is required for the network interface of the device, in-depth knowledge of PROFINET IRT networking internals and/or information from the official PROFINET IRT specifications may be required. In such cases, the persons responsible for the implementation of this product should either obtain the PROFINET IRT specification to gain sufficient knowledge or limit their implementation in such a way that this is not necessary.

For additional information, please visit the support website at www.anybus.com/support.

1.2 Document History

Version	Date	Description
1.0	2019-05-16	First release
1.1	2020-07-03	Minor updates and corrections

1.3 Document Conventions

Numbered lists indicate tasks that should be carried out in sequence:

1. First do this
2. Then do this

Bulleted lists are used for:

- Tasks that can be carried out in any order
- Itemized information

► An action

→ and a result

User interaction elements (buttons etc.) are indicated with bold text.

```
Program code and script examples
```

Cross-reference within this document: *Document Conventions, p. 3*

External link (URL): www.hms-networks.com

WARNING
Instruction that must be followed to avoid a risk of death or serious injury.

Caution
Instruction that must be followed to avoid a risk of personal injury.

Instruction that must be followed to avoid a risk of reduced functionality and/or damage to the equipment, or to avoid a network security risk.

Additional information which may facilitate installation and/or operation.

1.4 Document Specific Conventions

- The terms “Anybus” or “module” refers to the Anybus CompactCom module.
- The terms “host” or “host application” refer to the device that hosts the Anybus.
- Hexadecimal values are written in the format NNNNh or 0xNNNN, where NNNN is the hexadecimal value.
- A byte always consists of 8 bits.
- All dimensions in this document have a tolerance of ±0.10 mm unless otherwise stated.
- Outputs are TTL compliant unless otherwise stated.
- Signals which are “pulled to GND” are connected to GND via a resistor.
- Signals which are “pulled to 3V3” are connected to 3V3 via a resistor.
- Signals which are “tied to GND” are directly connected to GND,
- Signals which are “tied to 3V3” are directly connected to 3V3.

1.4.1 Pin Types

The pin types of the connectors are defined in the table below. The pin type may be different depending on which mode is used.

Pin type	Definition
I	Input
O	Output
I/O	Input/Output (bidirectional)
OD	Open Drain
Power	Pin connected directly to module power supply, GND or 3V3

1.5 Trademark Information

Anybus® is a registered trademark of HMS Industrial Networks.

All other trademarks are the property of their respective holders.

2 About the Anybus CompactCom B40 Modbus Serial - PROFINET IRT

2.1 General Information

The Anybus CompactCom B40 Modbus Serial - PROFINET IRT is a communication solution for simple industrial field devices. The host application communicates with the product using the Modbus RTU protocol. The Anybus CompactCom B40 Modbus Serial - PROFINET IRT then communicates the data to the network. Typical applications are basic level I/O blocks, temperature controllers, measuring devices, and sensors.

The Anybus CompactCom B40 Modbus Serial - PROFINET IRT software interface is designed to be network protocol independent, making it possible to support several networking systems using the same application software code/driver.

The Anybus CompactCom B40 Modbus Serial - PROFINET IRT share footprint and electrical interface with the other members of the product family, independent of fieldbus or network. The host application connector provides an interface between the host application (Modbus RTU) and the Anybus CompactCom, while the network connector provides access to the chosen network. The Anybus CompactCom acts as a Modbus RTU slave on the host application side.

The Anybus CompactCom 40 family offers a wide range of functionality. For advanced products and applications, we recommend the standard Anybus CompactCom 40.

For general information about other products using the Anybus CompactCom 40 platform, consult www.anybus.com/support.

This a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

This product contains ESD (Electrostatic Discharge) sensitive parts that may be damaged if ESD control procedures are not followed. Static control precautions are required when handling the product. Failure to observe this may cause damage to the product.

2.2 Features (PROFINET IRT)

- Max. read process data: 1400 bytes
- Max. write process data: 1400 bytes
- Max. process data (read + write, in bytes): 2800 bytes
- Complies with PROFINET IO Conformance class C
- Supports 250 µs cycle time
- Galvanic isolation between the host application and the industrial network available if used with the CompactCom B40 connector board
- SNMP agent
- Web server w. customizable content
- FTP server
- Device identity customization
- Supports PROFINET Fast Start Up
- Supports Media Redundancy Protocol (MRP)

> **!** All Anybus CompactCom 40 Modbus Serial, where the host is running an example application, will be precertified for network conformance. This is done to ensure that the final product can be certified, but it does not necessarily mean that the final product does not require recertification. Contact HMS Industrial Networks for further information.

2.3 Overview

The picture below shows the data flow in the Anybus CompactCom B40 Modbus Serial - PROFINET IRT. The application sets up the Modbus RTU communication, and the Anybus CompactCom maps the process data to the industrial network/fieldbus.

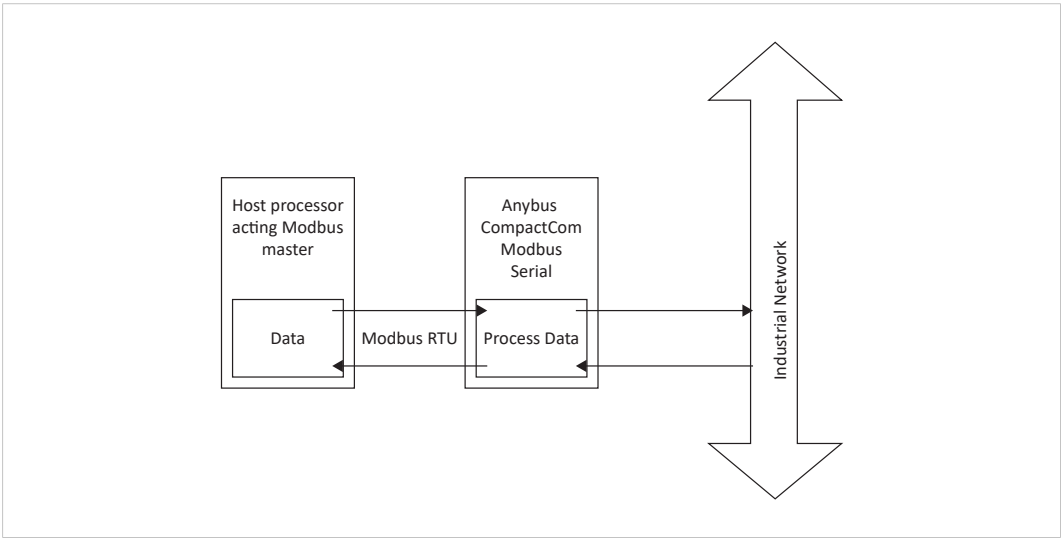


Fig. 1

3 Basic Operation

3.1 GSDML

On PROFINET IRT, the characteristics of a device are stored in an XML formatted configuration file with the suffix XML. This file is used by configuration tools etc. when setting up the network configuration. HMS Industrial Networks supplies a tool for generating a GSDML file based on a user configuration, please consult www.anybus.com/support for more information. HMS Industrial Networks also supplies a standard GSDML-file template that can be used as a basis when making the user configuration and its corresponding GSDML file.

3.2 Network Identity

By default, the module uses the following identity settings:

Vendor ID:	010Ch (HMS Industrial Networks)
Device ID:	0010h (Anybus CompactCom 40 PROFINET)
Product Name:	“CompactCom 40 PIR”
Order ID:	“CompactCom 40 PIR”
Serial Number:	Assigned during manufacturing
Station Name	"CompactCom-40-PIR-XXX"

The identity of the device can be customized, see...

- *Startup and Identity Customization, p. 8*

3.3 Startup and Identity Customization

To customize the identity of the Anybus CompactCom (e.g. Vendor ID, Device ID, etc.), Virtual Attributes are used.

The most common customizations will be described here. For more detailed information, see the related documents listed in the beginning of this document.

Setting up the virtual attributes in the Anybus CompactCom can be accomplished in two different ways.

- Using the user-defined Modbus function code (Function code 70).

  The use of Function code 70 can be included in the Modbus master. Hence the CompactCom does not need to be preprogrammed before mounting it in the host application.

- Using the Anybus Virtual Attributes Manager.

  The Virtual Attributes Manager is recommended for use during development and for low volume production, since manual user operations are needed for every Anybus CompactCom that shall be programmed.

Once the virtual attributes are written to the Anybus CompactCom, they are saved in non-volatile memory. It is not necessary to write the virtual attributes at each startup.

3.3.1 Virtual Attributes with Specific Modbus Function Code 70

With Modbus function code 70, the Modbus master has access to the Anybus CompactCom internal messaging protocol. This means that all attributes within the Anybus CompactCom are potentially accessible.

When writing the virtual attributes to the Anybus CompactCom, the Anybus object, Object 01h, Instance 1, Attribute 17 is used. All information relevant for the basic virtual attributes will be covered here. For more information, refer to the related documents section in this document.

The example shows example values to the basic virtual attributes:

Virtual Attribute	Example Value
Device ID:	0x0010
Vendor ID:	0x010C
I&M Order ID:	Order ID
I&M Revision Cnt:	1
Web Server:	Disabled
FTP Server:	Disabled
Serial Number:	0x12345678
Vendor Name:	Vendor Name
Product Name:	Product Name
Firmware Version:	1.2.3
Hardware Version:	3

To set the virtual attributes in the Anybus CompactCom to these values, using the Modbus function 70, create the request below:

The attribute data is sent in little-endian format.

Modbus function 70 Request

	Value	Note
Modbus Address	0xXX	
Function Code	0x46	FC70
Command	0x42	Set_Attribute
Object	0x01	Anybus Object
Instance	0x01	Instance 1
	0x00	
Ext0	0x11	Attribute 17
Ext1	0x00	Not used
Data Size	0x72	The data size in this example is 114 bytes
	0x00	
Data	0xF6 0x01 0x00 0x01 0x02 0x00 0x10 0x00 0xF6 0x01 0x00 0x02 0x02 0x00 0x0C 0x01 0xF6 0x01 0x00 0x08 0x08 0x00 0x4F 0x72 0x64 0x65 0x72 0x20 0x49 0x44 0xF6 0x01 0x00 0x0C 0x02 0x00 0x01 0x00 0xF9 0x01 0x00 0x03 0x01 0x00 0x00 0xF9 0x01 0x00 0x06 0x01 0x00 0x00 0xFF 0x01 0x00 0x03 0x04 0x00 0x78 0x56 0x34 0x12 0xFF 0x01 0x00 0x08 0x0B 0x00 0x56 0x65 0x6E 0x64 0x6F 0x72 0x20 0x4E 0x61 0x6D 0x65 0xFF 0x01 0x00 0x09 0x0C 0x00 0x50 0x72 0x6F 0x64 0x75 0x63 0x74 0x20 0x4E 0x61 0x6D 0x65 0xFF 0x01 0x00 0x0A 0x03 0x00 0x01 0x02 0x03 0xFF 0x01 0x00 0x0B 0x02 0x00 0x03 0x00	Device ID Vendor ID I&M Order ID I&M Rev Cnt Disable Web Disable FTP Serial Number Vendor Name Product Name Firmware Ver. Hardware Ver.
CRC	0xXX	CRC-16
	0xXX	

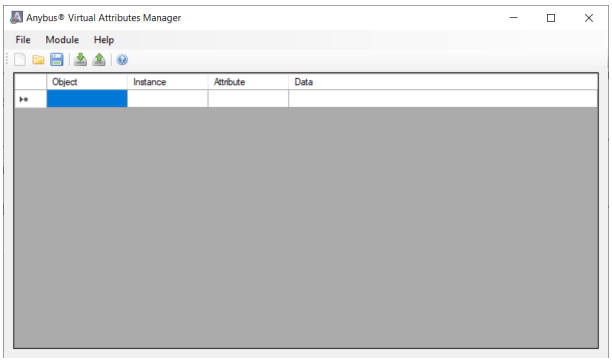
Response

	Value	Note
Modbus Address	0xXX	
Function Code	0x46	FC70
Command	0x02	Set_Attr_Resp
Object	0x01	Anybus Object
Instance	0x01	
	0x00	
Ext0	0x11	Attribute 17
Ext1	0x00	Not used
Data Size	0x00	
	0x00	
CRC	0xXX	CRC-16
	0xXX	

Requests with a size larger than 244 bytes will return Modbus exception code ILLEGAL DATA VALUE.

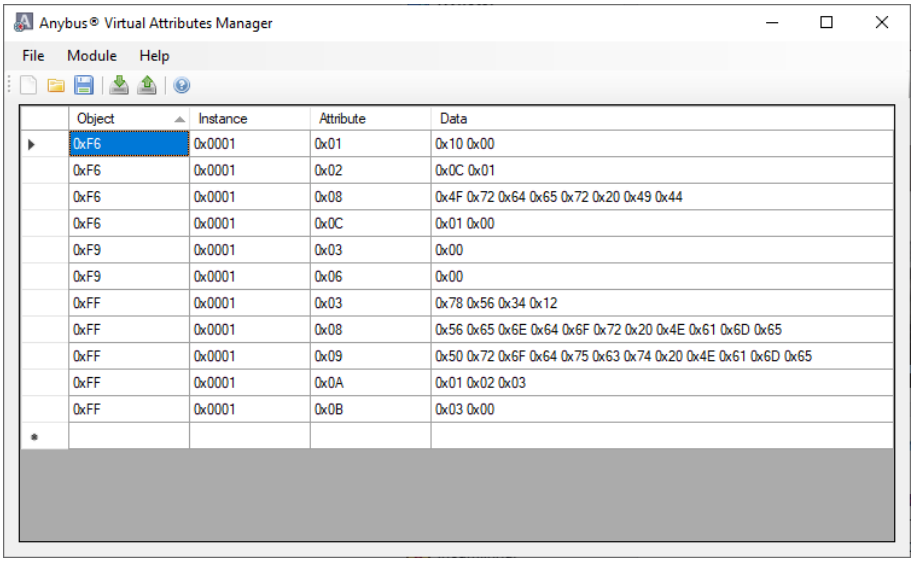
3.3.2 Virtual Attributes with Anybus Virtual Attributes Manager

1. Start the Anybus Virtual Attributes Manager



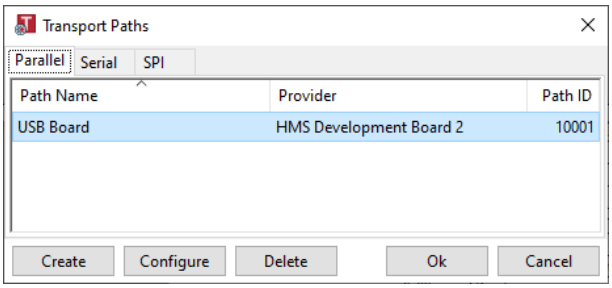
2. Enter the virtual attributes data for the attributes needed. The example below is setting up the attributes with the following values:

Virtual Attribute	Example Value
Device ID:	0x0010
Vendor ID:	0x010C
I&M Order ID:	Order ID
I&M Revision Cnt:	1
Web Server:	Disabled
FTP Server:	Disabled
Serial Number:	0x12345678
Vendor Name:	Vendor Name
Product Name:	Product Name
Firmware Version:	1.2.3
Hardware Version:	3



3. Mount the Anybus CompactCom to the USB starterkit board.

4. Select Module->Download and select the correct Transport Path to your USB board.



5. The virtual attributes will be programmed and saved in non-volatile memory.

3.4 Communication Settings

IP address communication settings are configured by the “Application switch 1” register. An application may select to write the value from a physical DIP switch, rotary switch or similar, to this register or it can assign it by other means.

“Application switch 2” is used for setting the PROFINET IRT station name.

Application switch 1 value	User communication settings	Comment
0	Use currently stored communication settings	Factory default stored communication settings: IP address: 0.0.0.0 Subnet mask: 0.0.0.0 Gateway address: 0.0.0.0 DHCP: OFF **Note**: Communication settings may be set by external software, see below.
1-254	IP address: 192.168.0.X Subnet mask: 255.255.255.0 Gateway address: 0.0.0.0 DHCP: OFF	Where X in the IP address is the “Application switch 1” value. Resulting communication settings are stored and can later be used if “Application switch 1” value is set to 0.
255	IP address: N/A Subnet mask: N/A Gateway address: N/A DHCP: ON	Communication settings received by DHCP are stored and can later be used if “Application switch 1” value is set to 0.

Application switch 2 value	User communication settings	Comment
0	Use the value saved in the non volatile memory	
1-255	Station Name	The application switch 2 sets the last three digits of the station name. Default Station name: “Station-Name-XXX”

The communication settings can also be changed from the internal web page, using Anybus the IPconfig tool, available at www.anybus.com/support or through the PROFINET IRT network. Note that changing the configuration through any of these interfaces will affect the currently used and/or stored configuration, but will only be used after the next restart if “Application switch 1” is set to 0.

See *Secure HICP (Secure Host IP Configuration Protocol), p. 20*.

3.5 Network Data Exchange

3.5.1 Process Data

Modbus Register	Content	PROFINET Information
0x5100	Data Type 0x0004: UINT8 (Default) 0x0005: UINT16	-
0x5102	No of Write Parameters	Max 1400 bytes
0x5103	No of Read Parameters	Max 1400 bytes
0x0000 – (Depending on Data type and No of Parameters)	Write Process Data	Parameters are packed in PROFINET slots. PROFINET slots contain up to a maximum of 248 parameters (UINT8/ UINT16) For examples, see *Mapping between Modbus Registers and PROFINET Slots, p. 13*.
0x1000 – (Depending on Data type and No of Parameters)	Read Process Data	Parameters are packed in PROFINET slots. PROFINET slots contain up to a maximum of 248 parameters (UINT8/ UINT16) For examples, see *Mapping between Modbus Registers and PROFINET Slots, p. 13*.
0x5004	Network Type	0x0089

3.5.2 Mapping between Modbus Registers and PROFINET Slots

Example 1 (From GSDML Example)

Data type: UINT16

No of Write Parameters: 260

No of Read Parameters: 10

PROFINET Slot	Modbus Register	Description
1	0x0000 - 0x00F7	248 words
2	0x00F8 - 0x0103	12 words
3	0x1000 - 0x1009	10 words

4 FTP Server

The built-in FTP-server makes it easy to manage the file system using a standard FTP client. It can be disabled using Modbus Function Code 70, see *Startup and Identity Customization, p. 8*.

> *If the FTP server is disabled, it is not possible to update the firmware from the network. If firmware updates from the network are desired, a method to re-enable the FTP server must be implemented.*

The following port numbers are used for FTP communication:

- TCP, port 20 (FTP data port)
- TCP, port 21 (FTP command port)

The FTP server supports up to two concurrent clients.

4.1 Session Example

The Windows Explorer features a built-in FTP client which can easily be used to access the file system as follows:

1. Open the Windows Explorer.
2. In the address field, type FTP://<address>
   – Substitute <address> with the IP address of the Anybus module
3. Press **Enter**. The Explorer will now attempt to connect to the Anybus module using the specified settings. If successful, the file system will be displayed in the Explorer window.

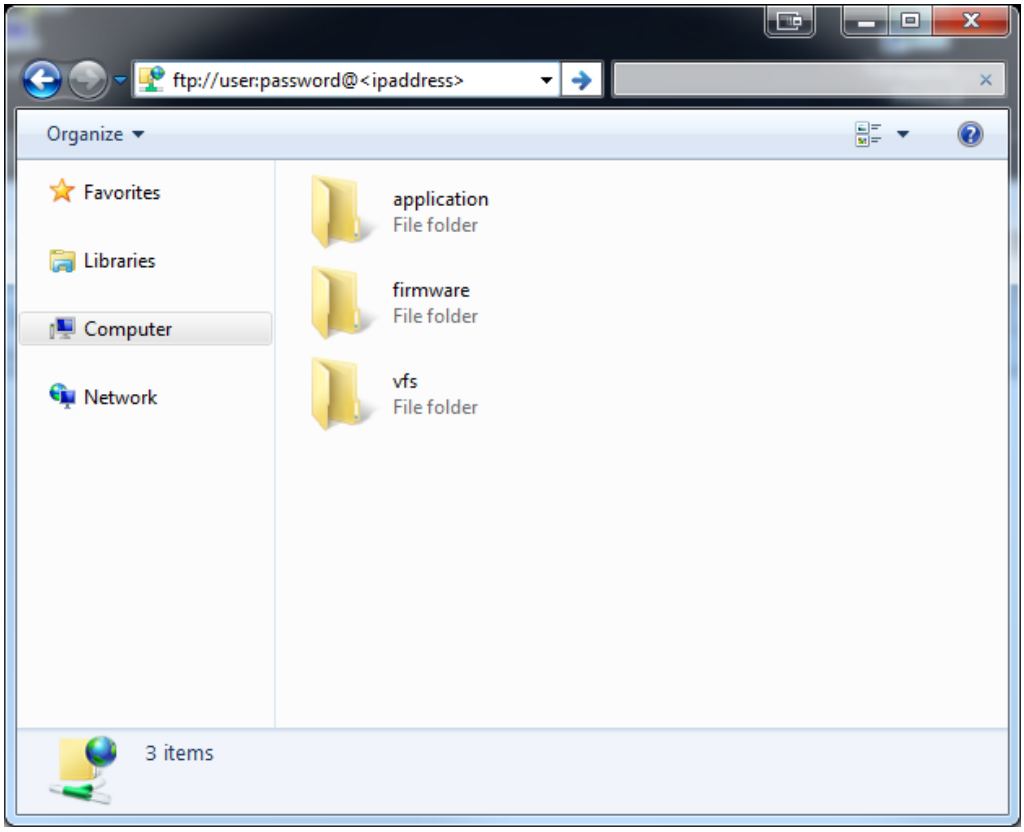


Fig. 2

5 Web Server

5.1 General Information

The built-in web server provides a flexible environment for end-user interaction and configuration purposes.

The web interfaces are stored in the file system, which can be accessed through the FTP server. If necessary, the web server can be completely disabled using Modbus Function Code 70, see *Startup and Identity Customization, p. 8*.

See also...

- *FTP Server, p. 14*

5.2 Web Pages

The web pages provide access to:

- Network configuration parameters
- Network status information
- Access to the host application parameters.

5.2.1 Network Configuration

The network configuration page provides interfaces for changing TCP/IP settings.

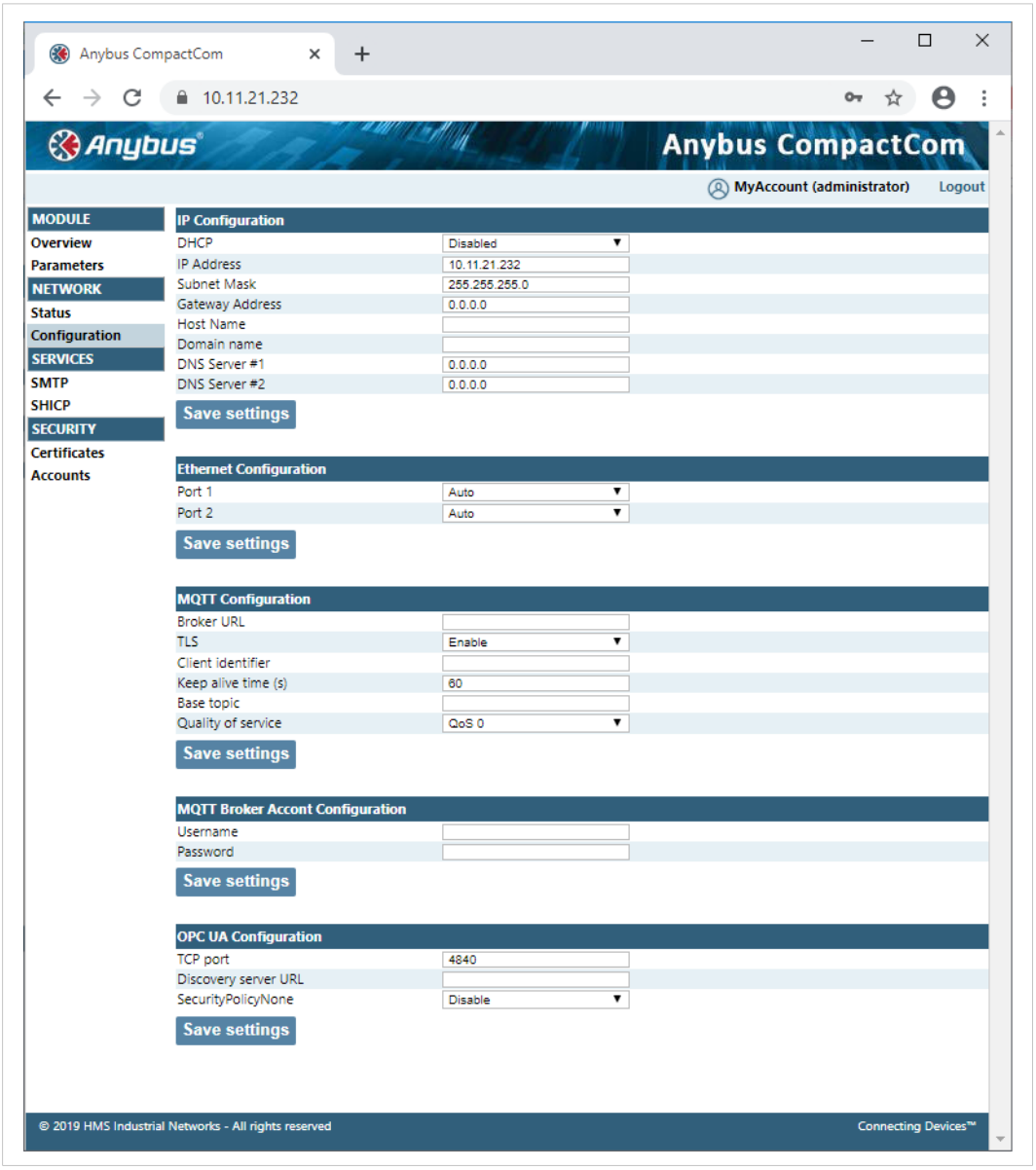


Fig. 3

The module needs to be reset for the TCP/IP settings to take effect. The Ethernet Configuration settings will take effect immediately.

IP Configuration

The module needs a reset for any changes to take effect. The settings will only be used if application switch 1 is set to 0.

Name	Description
DHCP	Enable or disable DHCP Default value: disabled
IP address	The TCP/IP settings of the module Default values: 0.0.0.0 Value ranges: 0.0.0.0 - 255.255.255.255
Subnet mask	
Gateway	
Host name	IP address or name

Name	Description
	Max 64 characters
Domain name	IP address or name Max 48 characters
DNS 1	Primary and secondary DNS server, used to resolve host name Default values: 0.0.0.0 Value ranges: 0.0.0.0 - 255.255.255.255
DNS 2	

Ethernet Configuration

Changes will take effect immediately.

Name	Description
Port 1	Ethernet speed/duplex settings Default value: auto
Port 2	

5.2.2 Ethernet Statistics Page

The Ethernet statistics web page contains the following information:

Ethernet Link		Description
Port 1	Speed:	The current link speed.
	Duplex:	The current duplex configuration.
Port 2	Speed:	The current link speed.
	Duplex:	The current duplex configuration.

Interface Counters	Description
In Octets:	Received bytes.
In Ucast Packets:	Received unicast packets.
In NUcast packets:	Received non unicast packets (broadcast and multicast).
In Discards:	Received packets discarded due to no available memory buffers.
In Errors:	Received packets discarded due to reception error.
In Unknown Protos:	Received packets with unsupported protocol type.
Out Octets:	Sent bytes.
Out Ucast packets:	Sent unicast packets.
Out NUcast packets:	Sent non unicast packets (broadcast and multicast).
Out Discards:	Outgoing packets discarded due to no available memory buffers.
Out Errors:	Transmission errors.

Media Counters	Description
Alignment Errors	Frames received that are not an integral number of octets in length.
FCS Errors	Frames received that do not pass the FCS check.
Single Collisions	Successfully transmitted frames which experienced exactly one collision.
Multiple Collisions	Successfully transmitted frames which experienced more than one collision.
SQE Test Errors	Number of times SQE test error messages are generated. (Not provided with current PHY interface.)
Deferred Transmissions	Frames for which first transmission attempt is delayed because the medium is busy.
Late Collisions	Number of times a collision is detected later than 512 bit-times into the transmission of a packet.
Excessive Collisions	Frames for which a transmission fails due to excessive collisions.
MAC Receive Errors	Frames for which reception of an interface fails due to an internal MAC sublayer receive error.
MAC Transmit Errors	Frames for which transmission fails due to an internal MAC sublayer receive error.

Media Counters	Description
Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempted to transmit a frame.
Frame Size Too Long	Frames received that exceed the maximum permitted frame size.
Frame Size Too Short	Frames received that are shorter than lowest permitted frame size.

A LED Indications

See Anybus CompactCom B40 Modbus Serial User Manual for more information.

A.1 Network Status LED

LED State	Description	Comments
Off	Offline	• No power • No connection with IO Controller
Green	Online (RUN)	• Connection with IO Controller established • IO Controller in RUN state
Green, 1 flash	Online (STOP)	• Connection with IO Controller established • IO Controller in STOP state or IO data bad • IRT synchronization not finished
Green, blinking	Blink	Used by engineering tools to identify the node on the network
Red	Fatal event	Major internal error (this indiction is combined with a red module status LED)
Red, 1 flash	Station Name error	Station Name not set
Red, 2 flashes	IP address error	IP address not set
Red, 3 flashes	Configuration error	Expected Identification differs from Real Identification

A.2 Module Status LED

LED State	Description	Comments
Off	Not Initialized	No power OR Module in SETUP or NW_INIT state
Green	Normal Operation	Module has shifted from the NW_INIT state
Red	Exception error	Device in state EXCEPTION
	Fatal event	Major internal error (this indication is combined with a red network status LED)
Alternating Red/Green	Firmware update	Do NOT power off the module. Turning the module off during this phase could cause permanent damage

A.3 LINK/Activity LEDs

LED State	Description	Comments
Off	No Link	No link, no activity
Green	Link	Ethernet link established, no activity
Green, flickering	Activity	Ethernet link established, activity

B Secure HICP (Secure Host IP Configuration Protocol)

B.1 General

The Anybus CompactCom B40 Modbus Serial - PROFINET IRT supports the Secure HICP protocol used by the Anybus IPconfig utility for changing settings, e.g. IP address, Subnet mask, and enable/disable DHCP. Anybus IPconfig can be downloaded free of charge from the HMS website, www.anybus.com. This utility may be used to access the network settings of any Anybus product connected to the network via UDP port 3250.

The protocol offers secure authentication and the ability to restart/reboot the device(s).

B.2 Operation

When the application is started, the network is automatically scanned for Anybus products. The network can be rescanned at any time by clicking **Scan**.

To alter the network settings of a module, double-click on its entry in the list. A window will appear, containing the settings for the module.

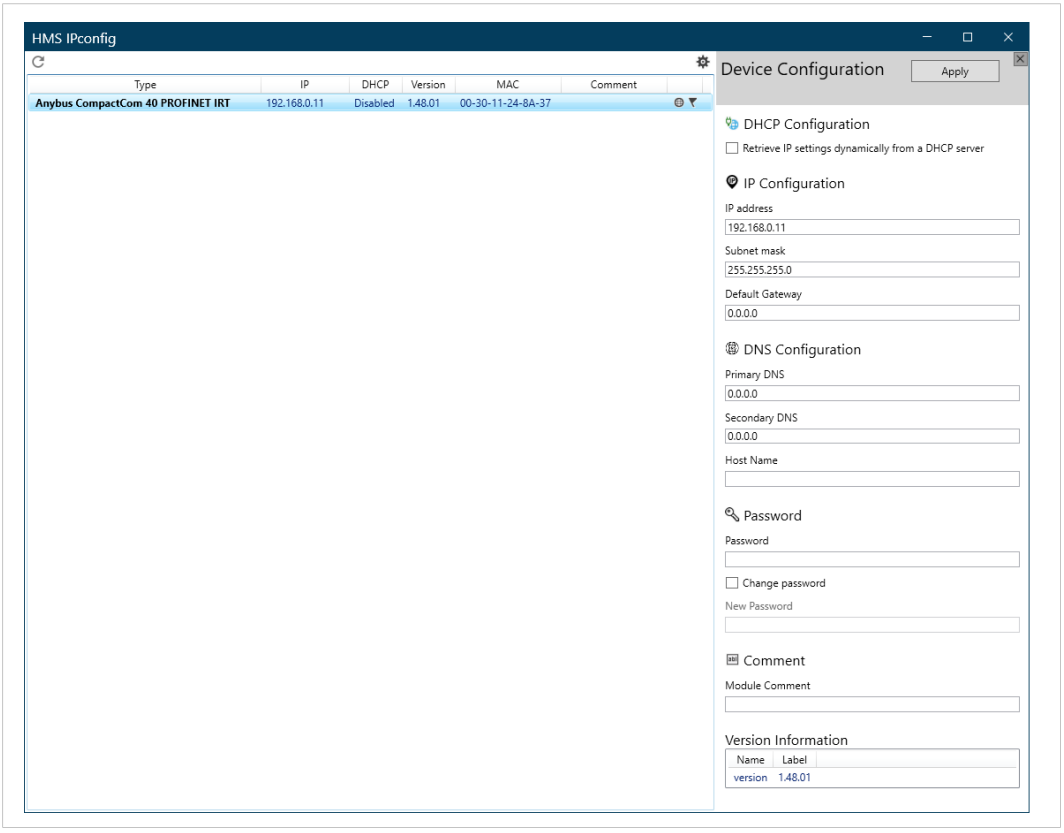


Fig. 4

Validate the new settings by clicking **Set**, or click **Cancel** to cancel all changes. Optionally, the configuration can be protected from unauthorized access by a password.

C Conformance Test Guide

C.1 General

When using the default settings of all parameters, the Anybus CompactCom B40 Modbus Serial - PROFINET IRT is precertified for network compliance. This precertification is done to ensure that the end product *can* be certified.

Changes in the parameters in the example GSDML file, supplied by HMS Industrial Networks, will require a certification. A vendor ID can be obtained from PI (PROFIBUS & PROFINET International) and is compulsory for certification. This chapter provides a guide for successful conformance testing your device, featuring the Anybus CompactCom B40 Modbus Serial - PROFINET IRT, in order to comply with the demands for network certification set by PI.

The actions described in this appendix have to be accounted for in the certification process. The identity of the product needs to be changed to match your company and device.

Please contact HMS Industrial Networks at www.anybus.com/support for more information.

C.2 Additional GSDML File Information

The GSDML file keyword “ProductFamily” shall correspond to the vendor’s name of the device.

The GSDML file keyword “MainFamily” lists the kinds of devices for which the product shall be listed. As of GSDML specification v2.3, the following “families” are available:

- “General”
- “Drives”
- “Switching Devices”
- “I/O”
- “Valves”
- “Controllers”
- “HMI”
- “Encoders”
- “NC/RC”
- “Gateway”
- “PLCs”
- “Ident Systems”
- “PA Profiles”
- “Network Components”
- “Sensors”

C.3 Documentation Considerations

To obtain a certificate, the following information must be present in the customer's user manual:

1. Behavior of the outputs if IOPS=BAD.
2. Behavior of the outputs if connection is aborted.
3. Behavior of the outputs at power on.

The Anybus CompactCom handles these situations in the following ways:

1. State change to IDLE. The network is informed that the I/O data of the submodule with IOPS=BAD is substituted with zeros (clear). No read process data is updated in the host interface.
2. State change to WAIT_PROCESS. The network is informed that the I/O data of all submodules is substituted with zeros (clear). No process data is updated in the host interface.
3. The network is informed that the I/O data of all submodules is substituted with zeros (clear). No process data is updated in the host interface.

Information about the compliance of the optical interface with the non IEE 802.3 MAU-type POF should also be provided in the documentation, see Fiber Optics Compliance (MAU type Compliance), p. 219.

C.4 Changes in GSDML File for Conformance Class B

The example GSDML file, supplied by HMS Industrial Networks, is adapted for testing a Anybus CompactCom B40 Modbus Serial - PROFINET IRT for conformance class C. If the implementation does not need the isochronous features of the device, the GSDML file can be modified to mirror this. The implementation can then be conformance tested for conformance class B instead. The list below describe the changes needed in the example GSDML file to accomplish this.

1. The value of the ConformanceClass attribute in the `<CertificationInfo...>` element in each DAP must be changed from “C” to “B”: `<CertificationInfo ConformanceClass=“B” ApplicationClass=“” NetloadClass=“III”/>`
2. The value of the SupportedRT_Classes attribute in the `<InterfaceSubmoduleItem...>` element in each DAP must be “RT_CLASS_1”. I.e. “RT_CLASS_3” must be removed:

   ```
   <InterfaceSubmoduleItem ID=“Interface” SubslotNumber=“32768” SubmoduleIdentNumber=“0x00000002” SupportedRT_Classes=“RT_CLASS_1” TextId=“T_ID_INTERFACE” SupportedProtocols=“SNMP;LLDP” SupportedMibs=“MIB2” DCP_HelloSupported=“true” PTP_BoundarySupported=“true” DCP_BoundarySupported=“true” DelayMeasurementSupported=“true”>
   ```

3. The elements `<RT_Class3Properties ...>`, `<SynchronisationMode ...>`, and `<RT_Class3TimingProperties ...>` must be removed from each DAP

C.5 SYNC Pin Measurements for Conformance Class C Test

For a conformance class C (IRT) test, access to the SYNC pin must be provided to the test lab.

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